

Intercomparisons of AIRS and NAST retrievals with Dropsondes During P-TOST

(Pacific Thorpex Observational System Test)



NASA ER-2



Dropsonde



NOAA G-IV



Empirical Orthogonal Function (EOF)

NAST-I/AIRS Regression Retrieval

For clear sky and opaque cloud:

$$R = \varepsilon_{s,c} B_{s,c} \tau_{s,c} - \int_{P_{ac}}^{P_{s,c}} Bd \tau - (1 - \varepsilon_{s,c}) \tau_{s,c} \int_0^{P_{s,c}} Bd \tau^*$$

**Radiance EOF
Amplitudes**

$$C_i = \sum_{j=1}^{n_c} R_j E_{ji}$$

$$\left. \begin{array}{l} T_s, \\ \varepsilon_s(v), \\ T(p), \\ Q(p) \end{array} \right\} = \sum_{i=1}^{n-1} K_{mi} C_i + K_{mn} P_s \quad \text{Retrieval Solution}$$

R = radiance

$\varepsilon_{s,c}$ = surface or cloud emissivity

$B_{s,c}$ = surface or cloud Planck radiance

τ = transmittance between aircraft and atmospheric Pressure level (P)

$\tau_{s,c}$ = atmospheric transmittance between aircraft and surface or cloud ($P_{s,c}$)

τ^* = atmospheric transmittance between surface or cloud P and aircraft

P_{ac} = aircraft pressure, P_s = surface pressure

\Re = radiance

E = radiance covariance EOFs

C = radiance EOF amplitudes

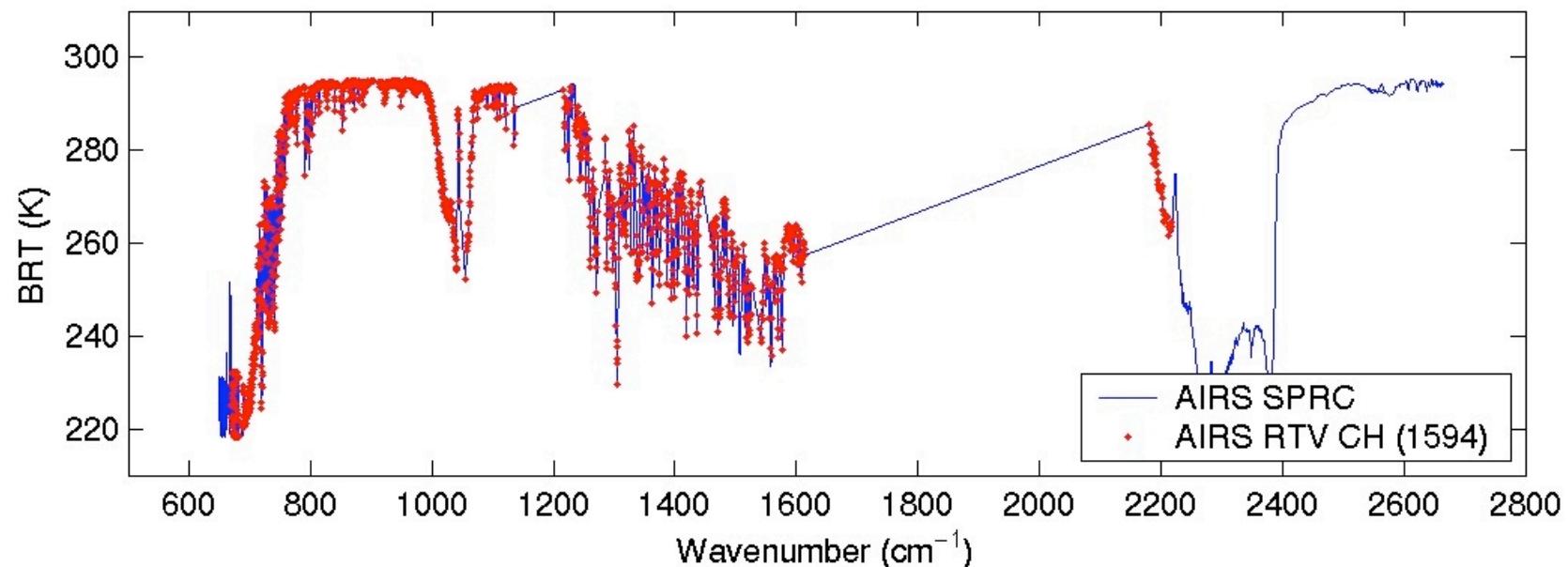
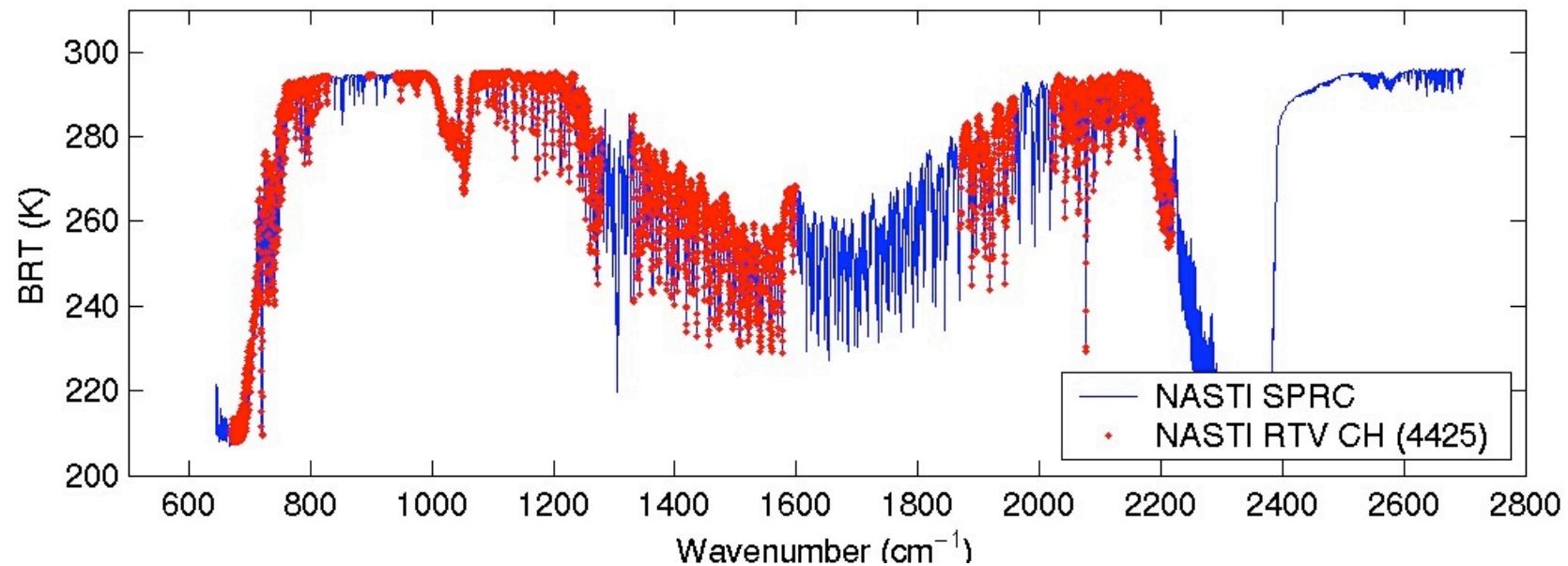
T = temperature

Q = H₂O mixing ratio

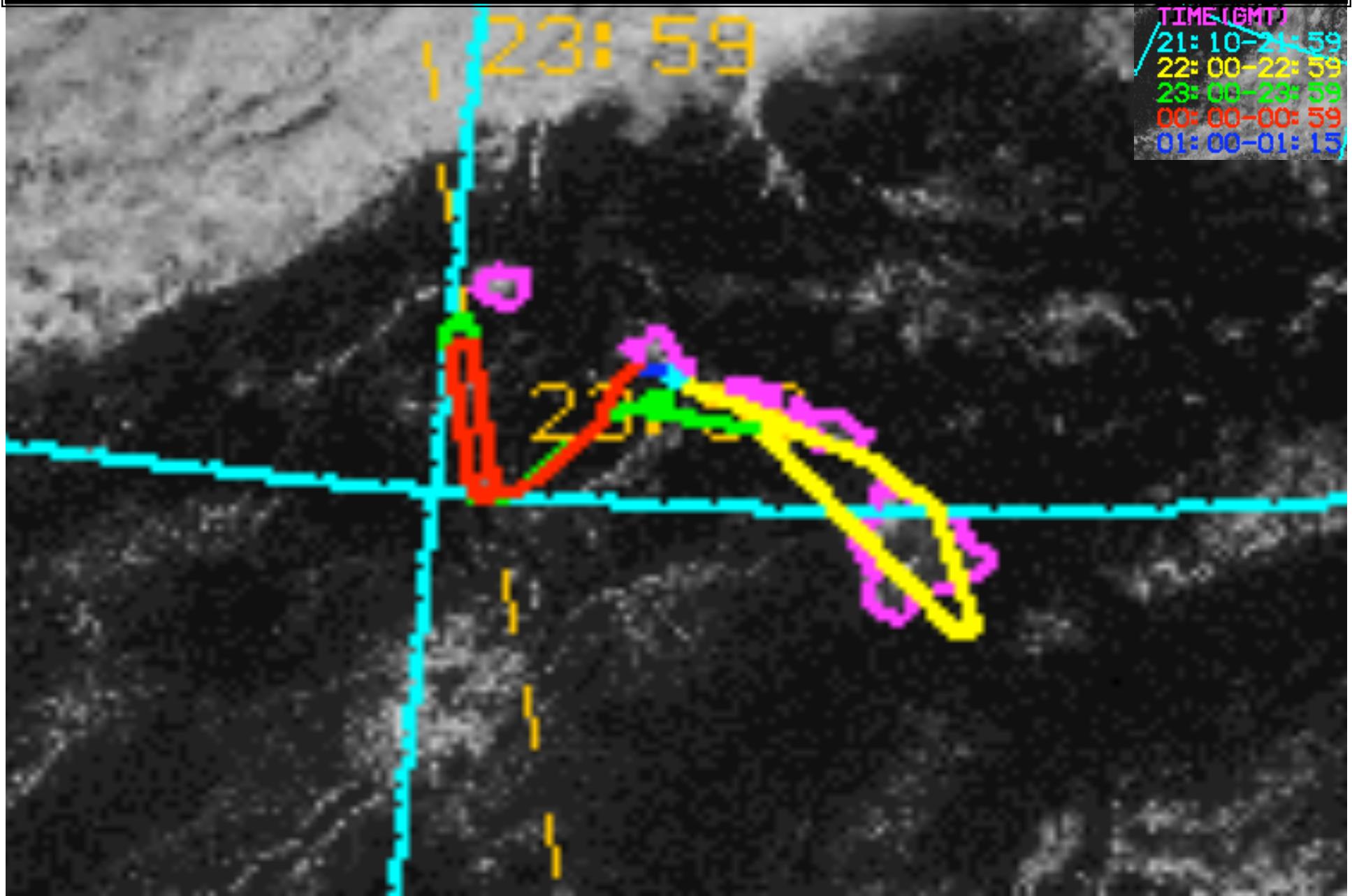
K = regression coefficients

- Physical Regression – EOFs and regression training based on calculated radiances
- Training includes cloud, sfc. emissivity, skin temp, and solar variability effects
- Null radiance errors assumed for PC specification and regression training
- EOF # selected by spatial radiance RMSD (observed minus retrieval) minimization

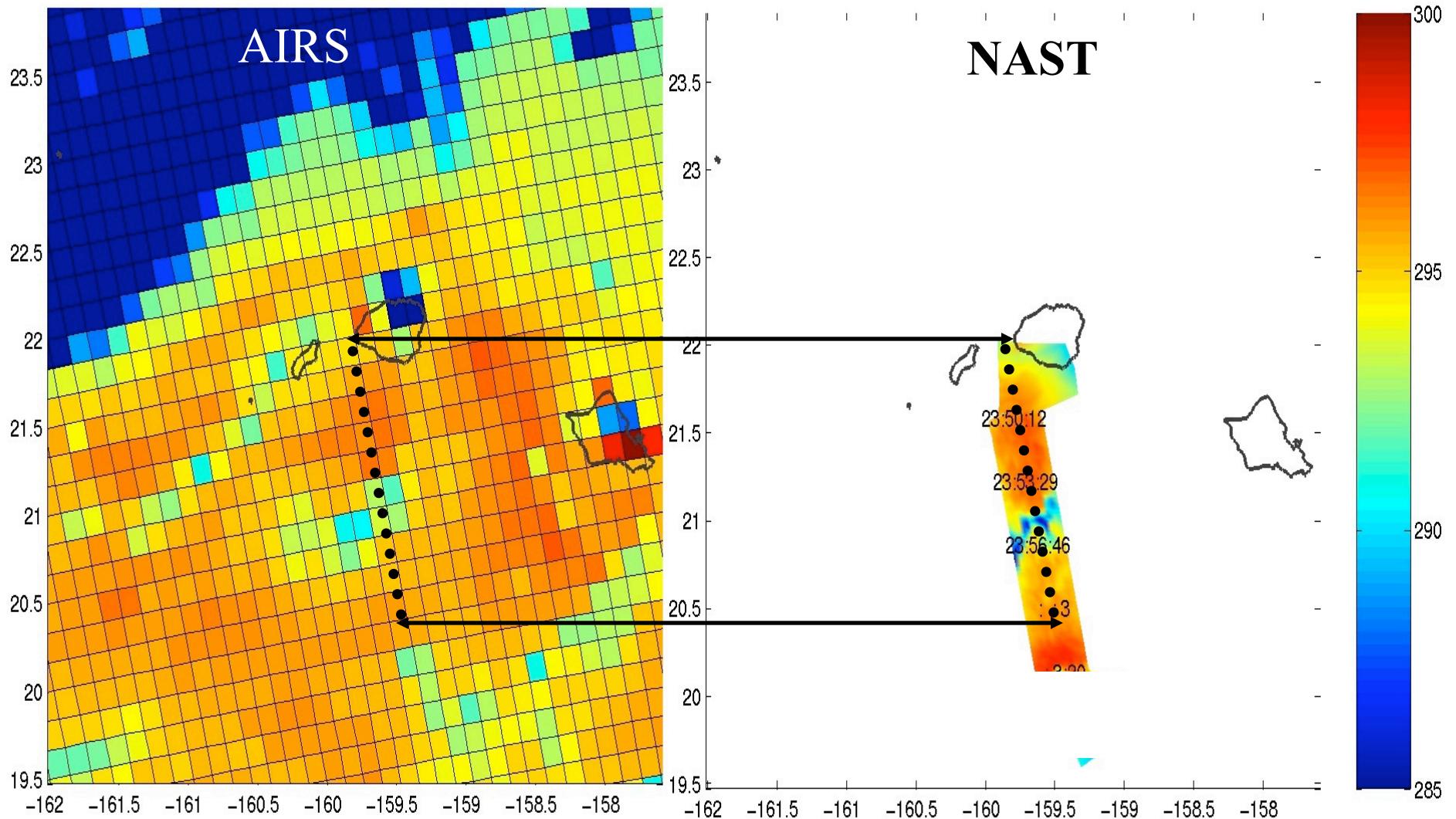
NAST-I and AIRS Spectra and Retrieval Channels



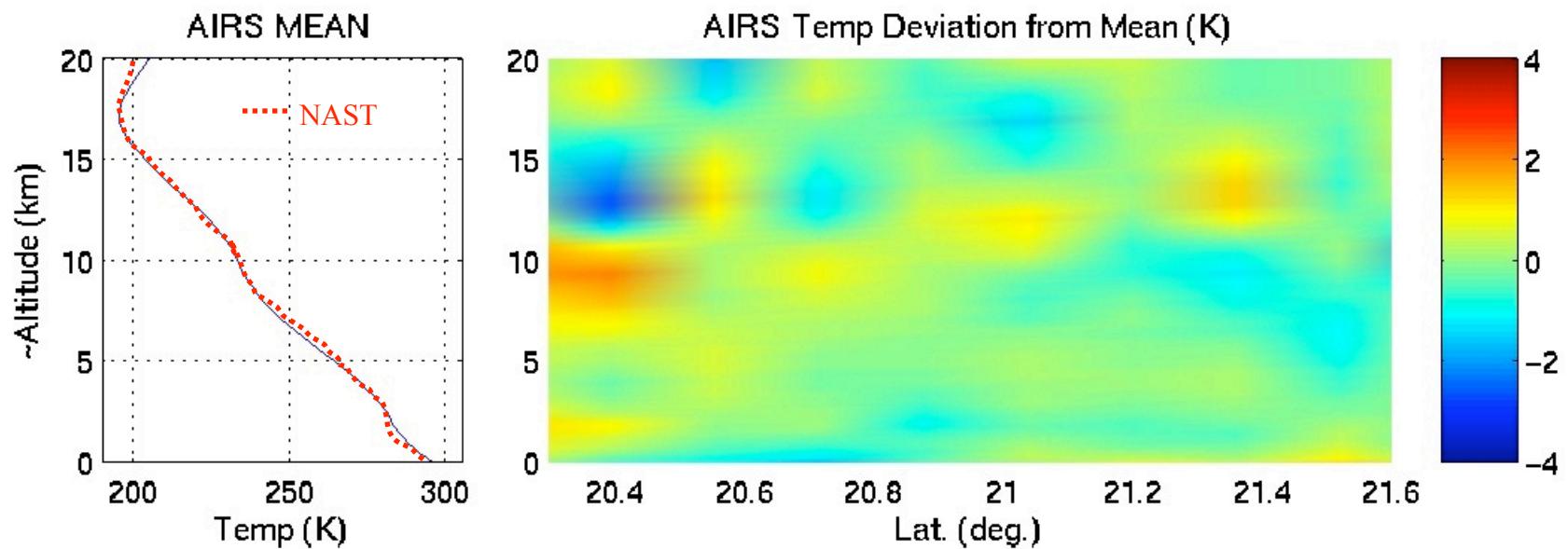
Aqua Overpass Flight (March 3, 2003)



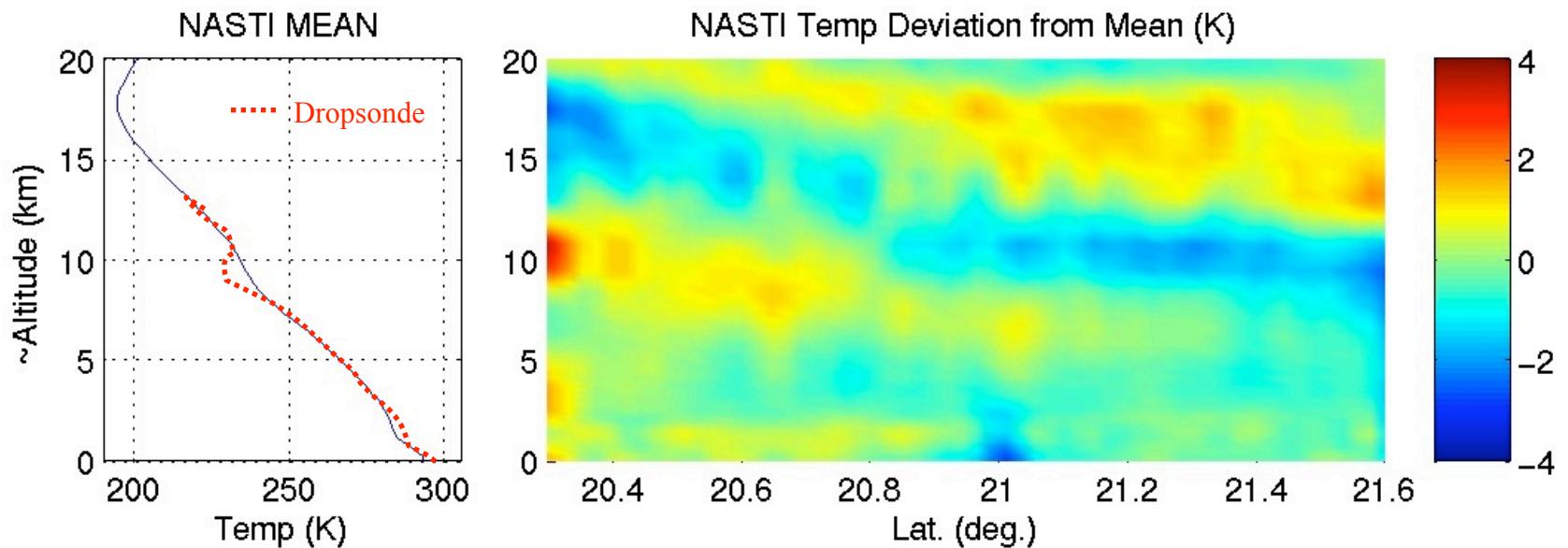
AIRS and NAST Date Used for Intercomparison



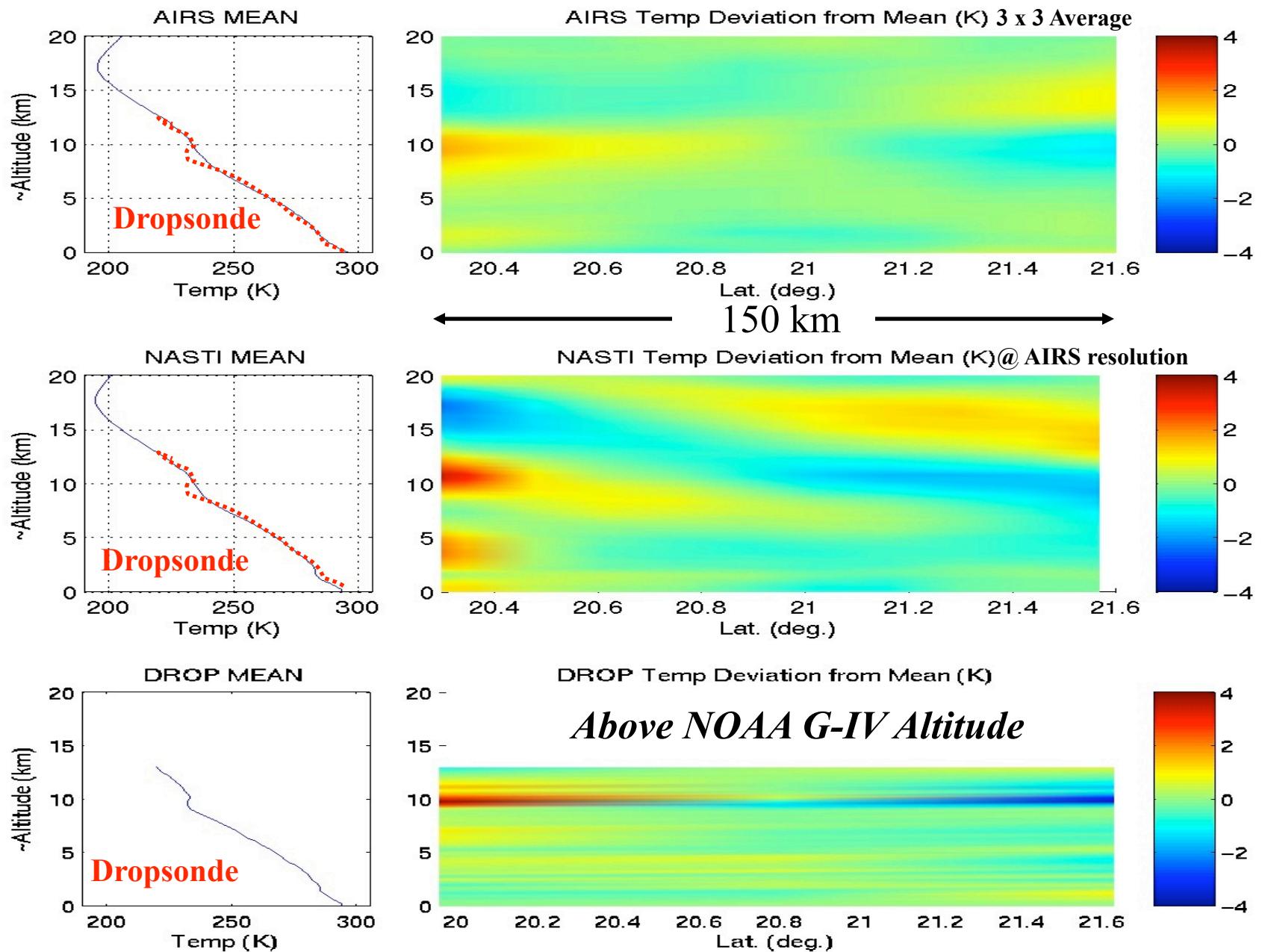
Retrieval Comparisons (Full Resolution AIRS vs NAST)



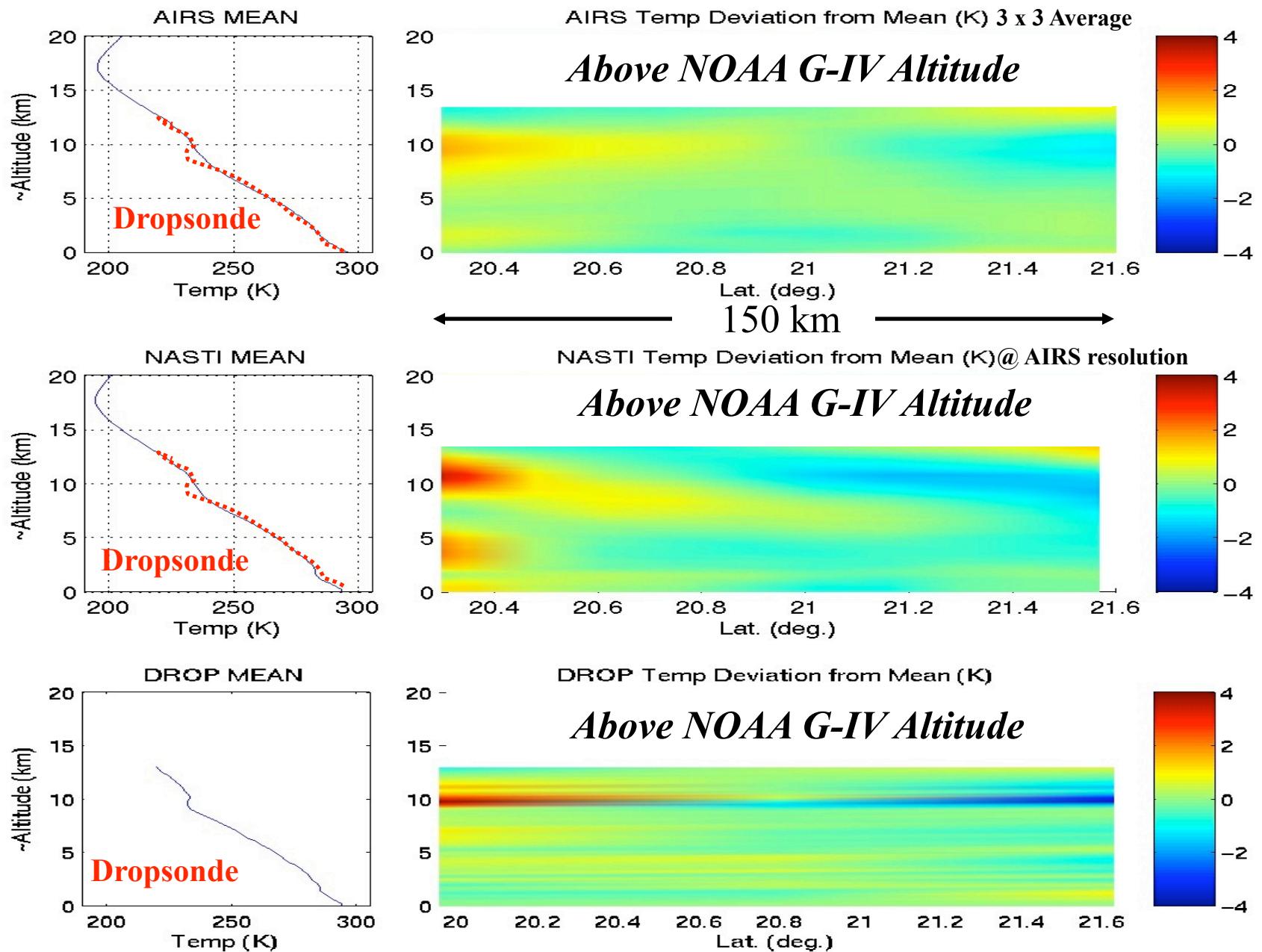
Some Differences in fine scale structure but spatial average is in good agreement



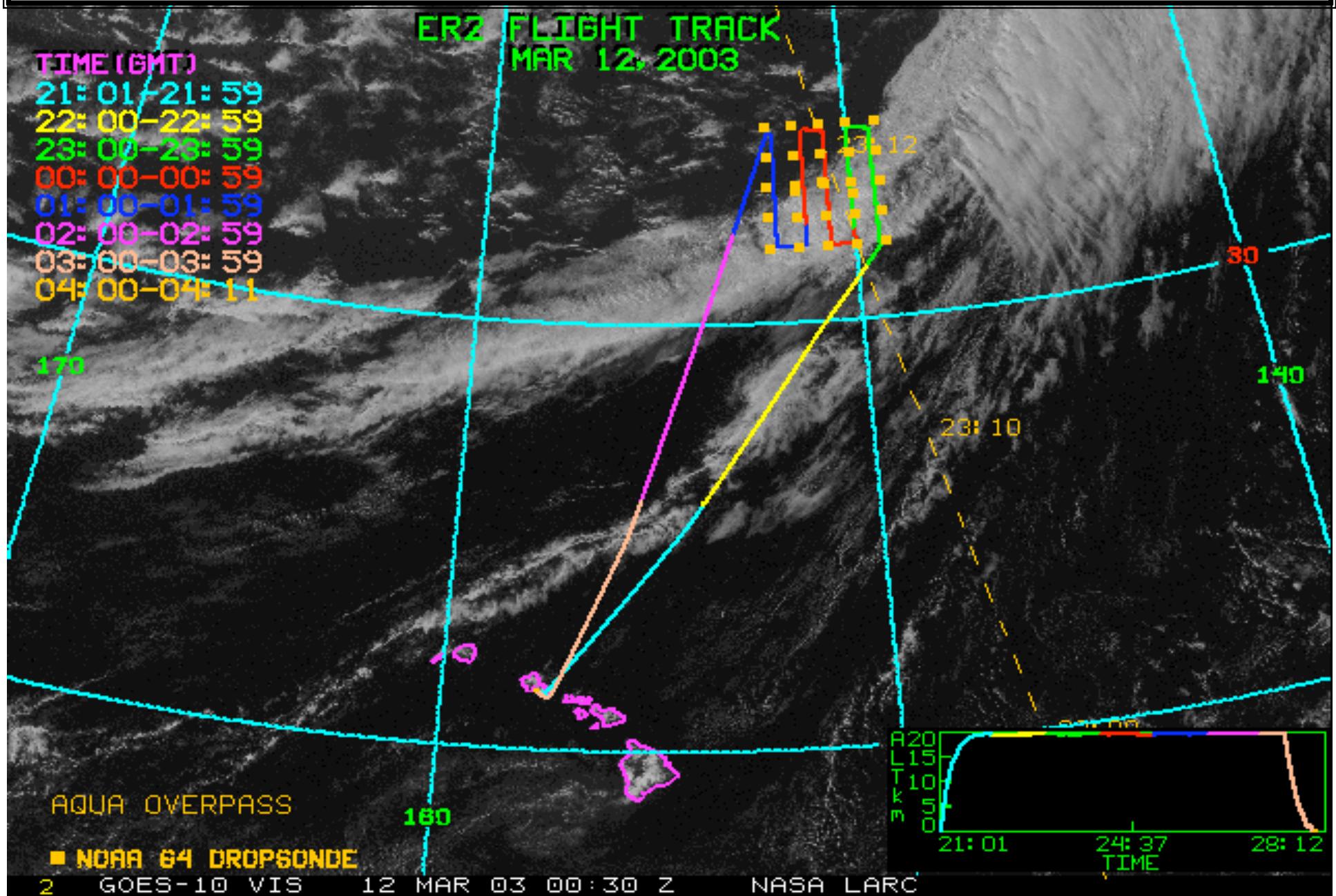
3 x 3 AIRS Average Vs NAST & Dropsonde Cross-sections



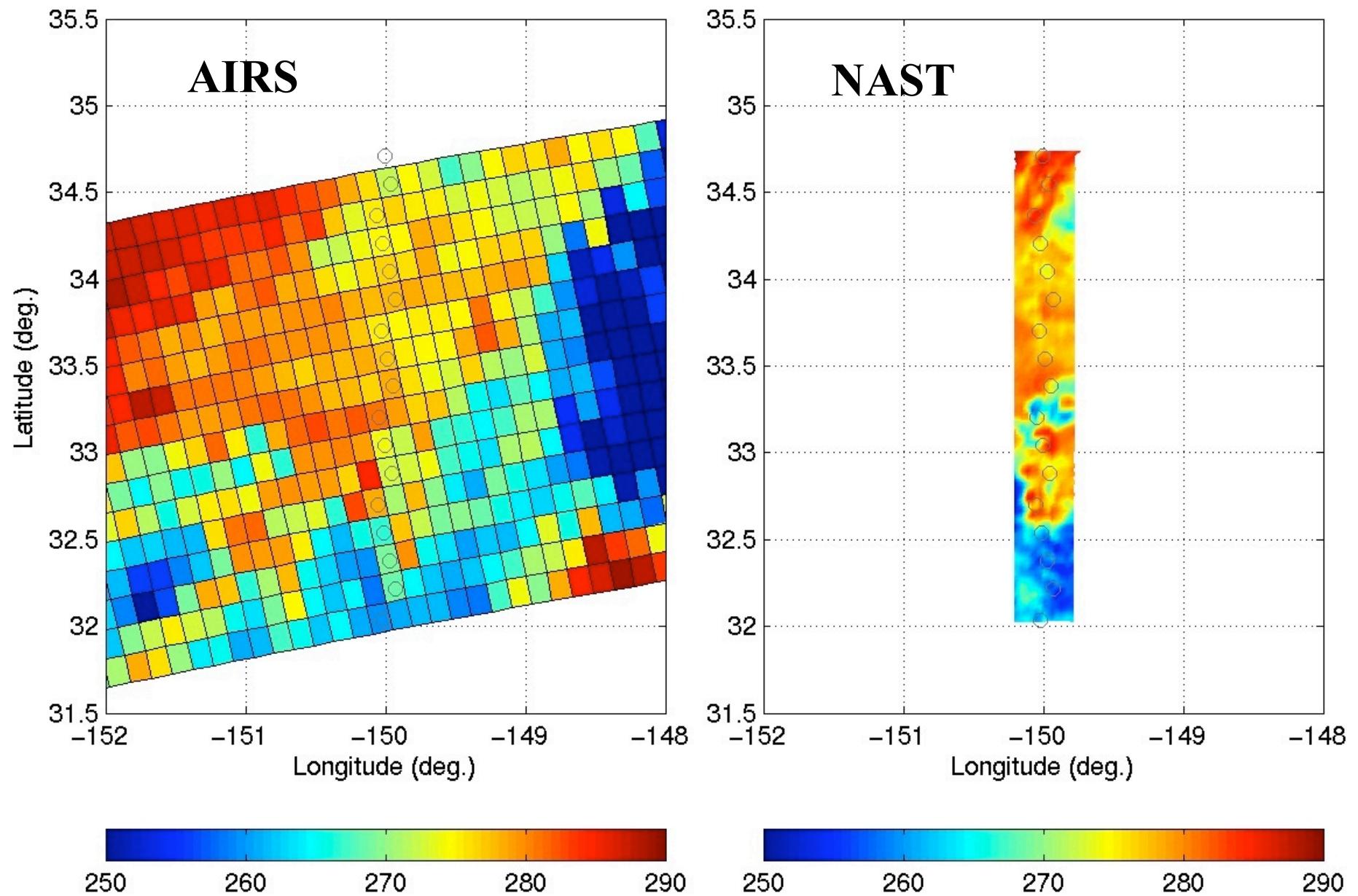
3 x 3 AIRS Average Vs NAST & Dropsonde Cross-sections



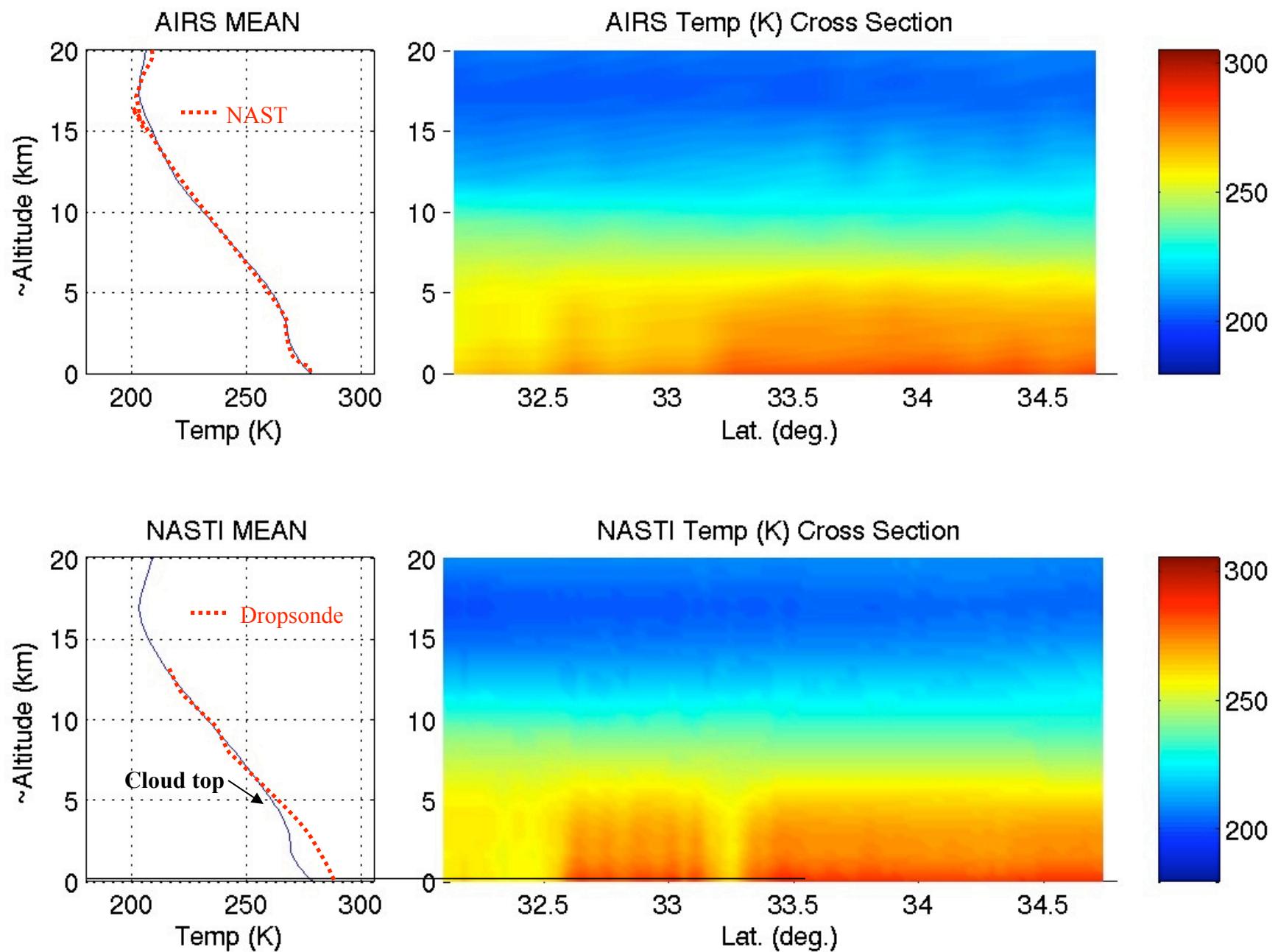
Aqua Overpass Flight (March 11/12, 2003)



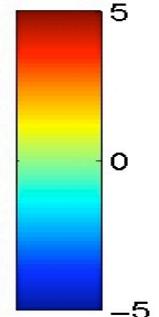
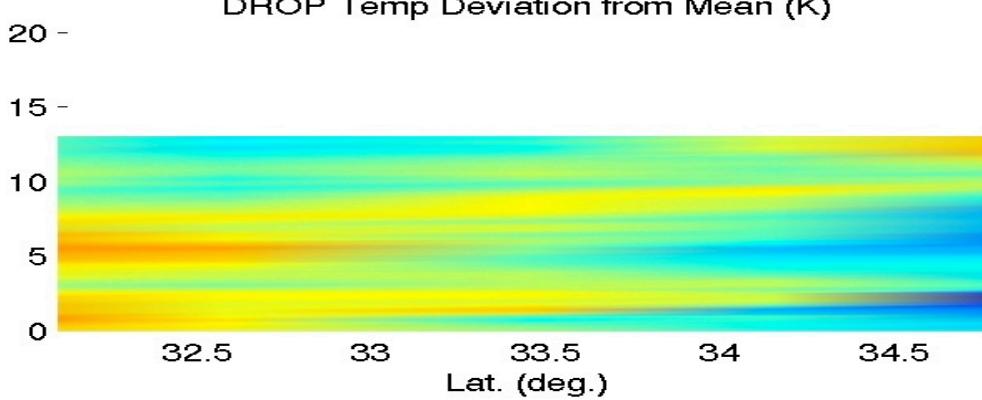
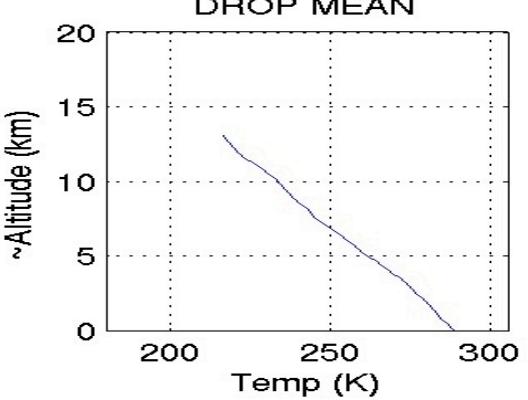
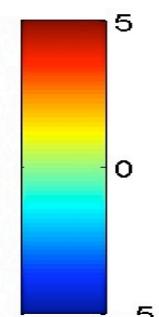
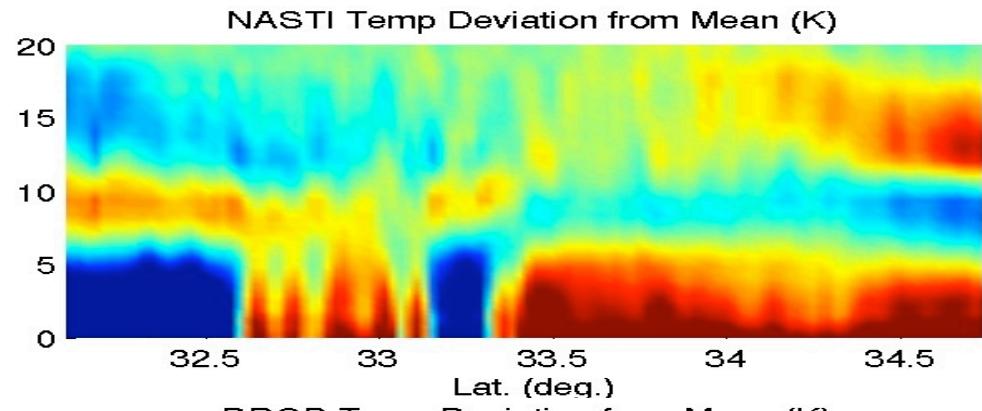
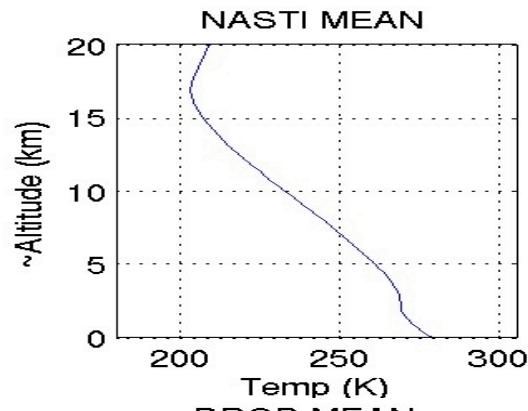
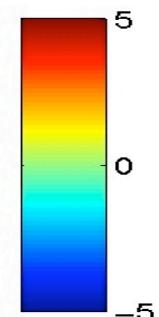
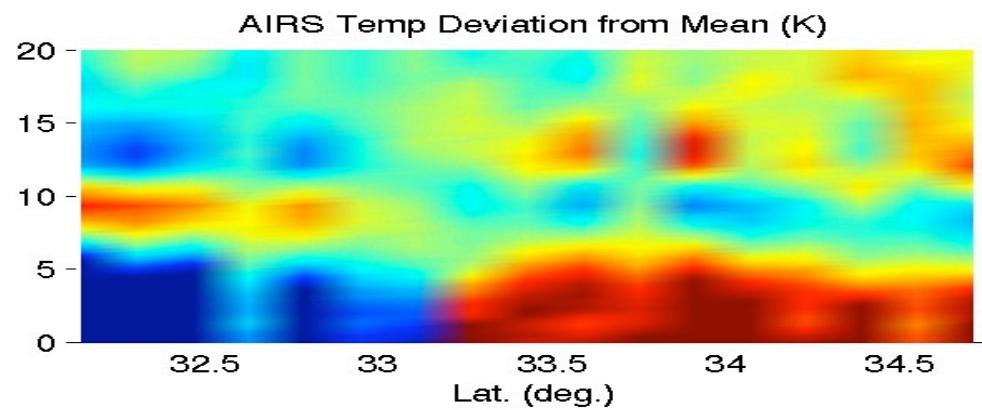
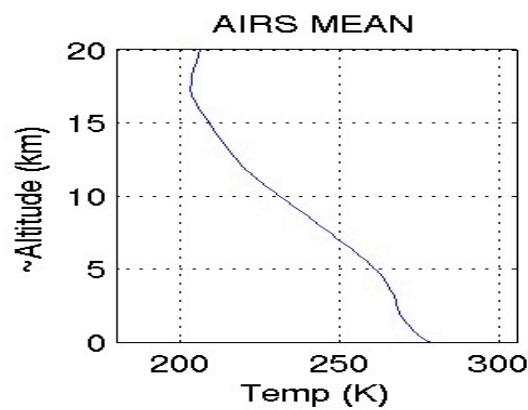
Surface/Cloud Temperature (March 11/12, 2003)



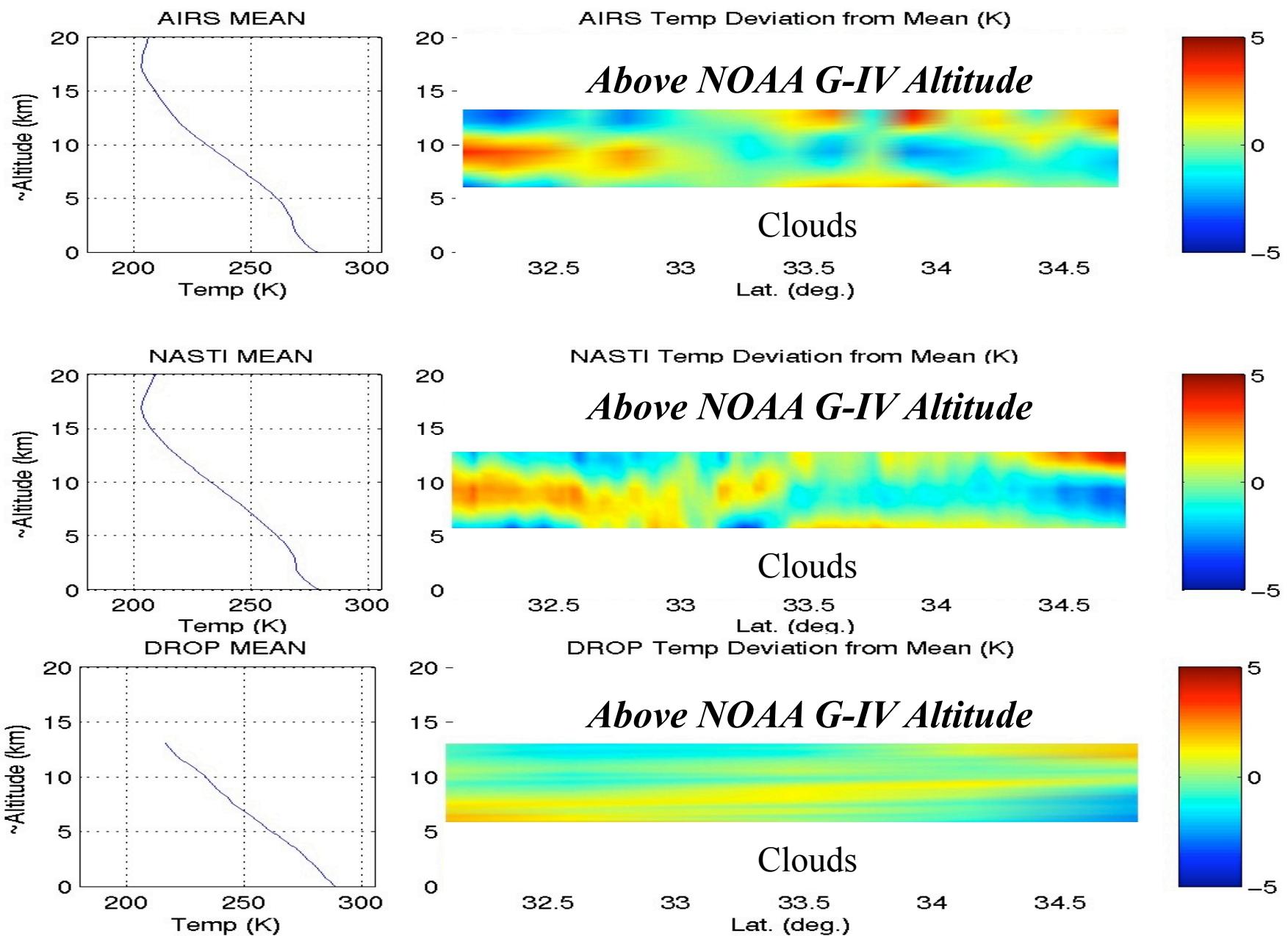
Temperature (March 11/12, 2003)



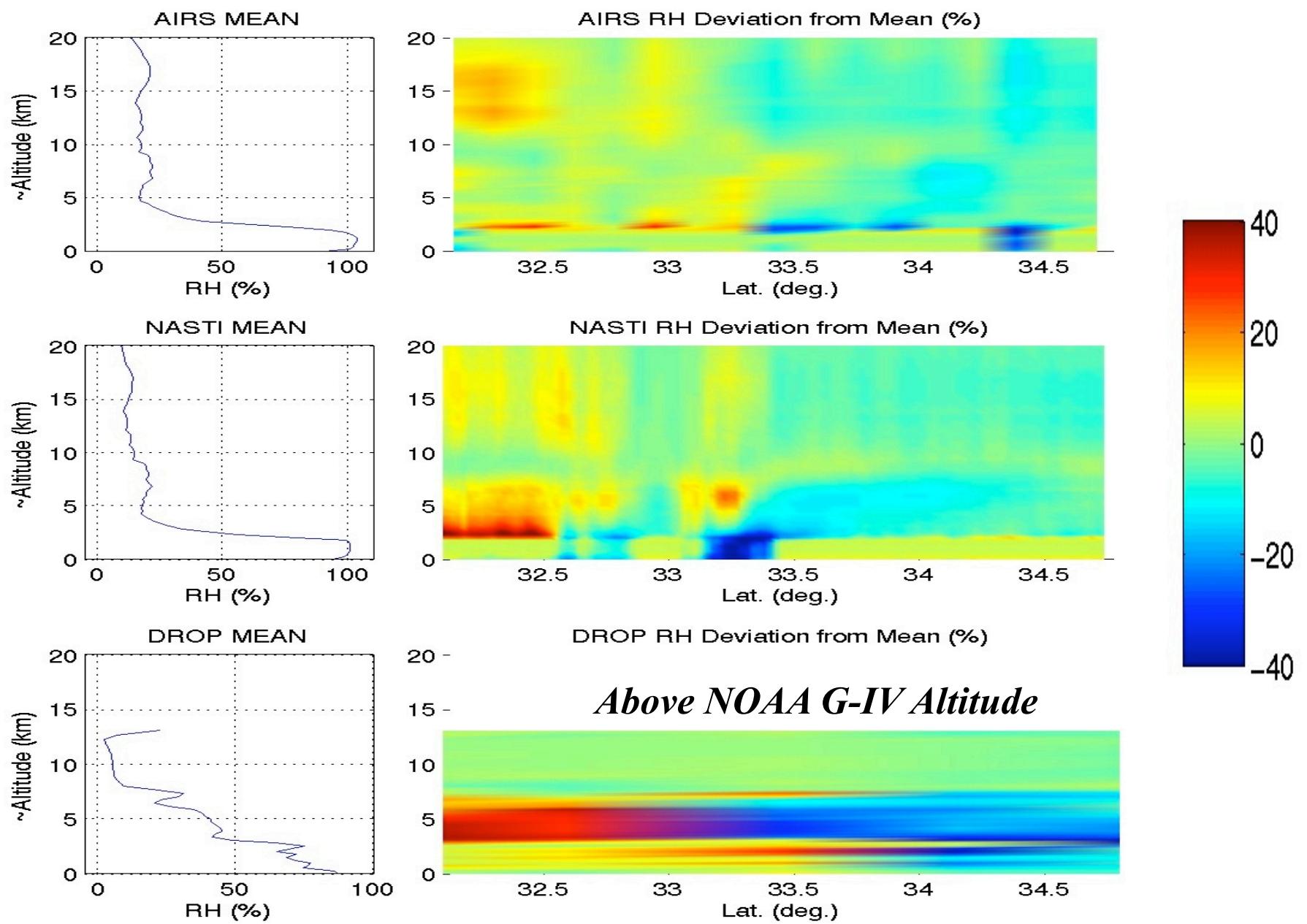
Temperature Deviation (March 11/12, 2003)



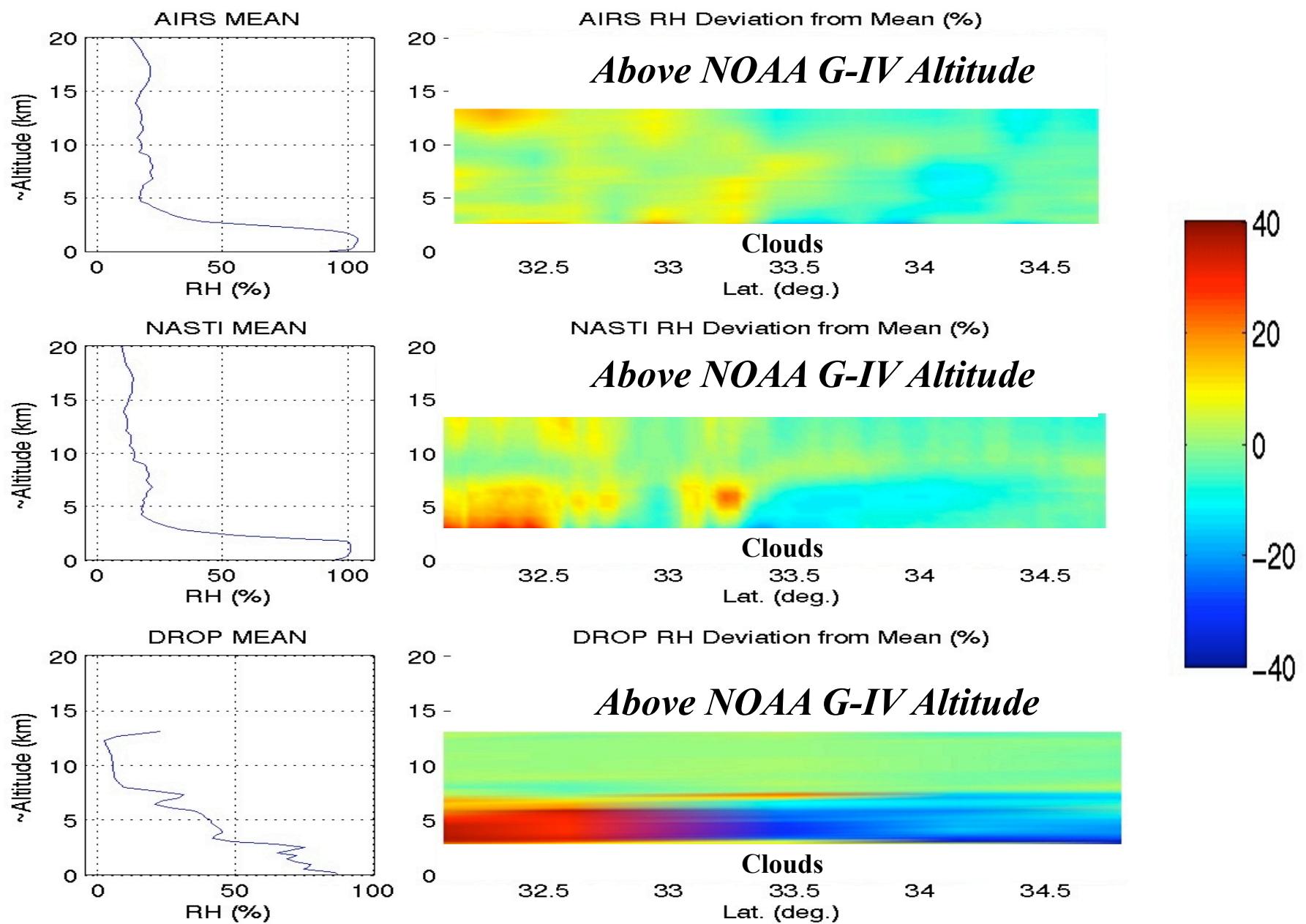
Temperature Deviation (March 11/12, 2003)



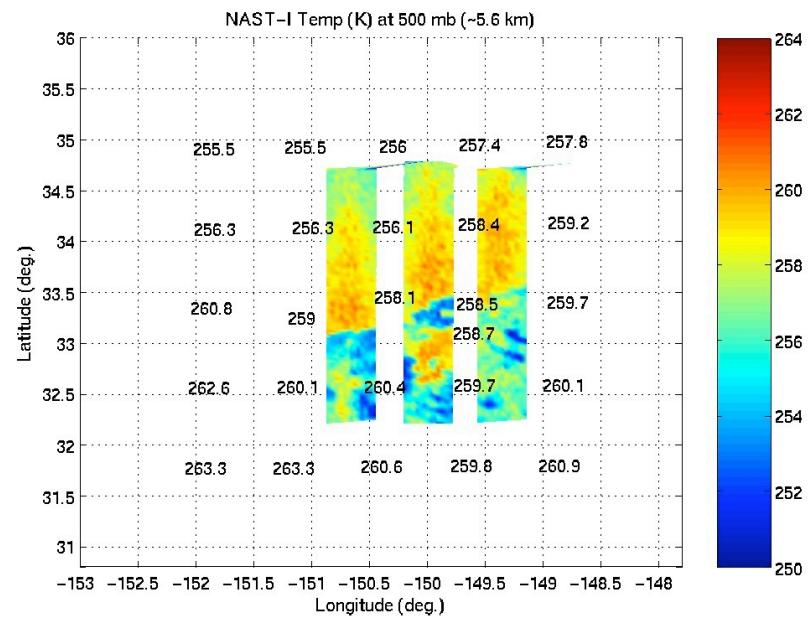
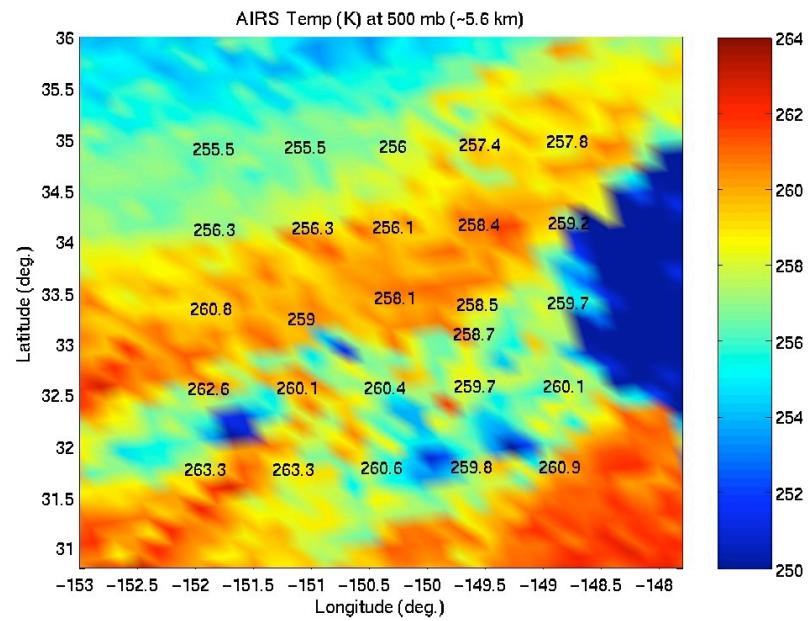
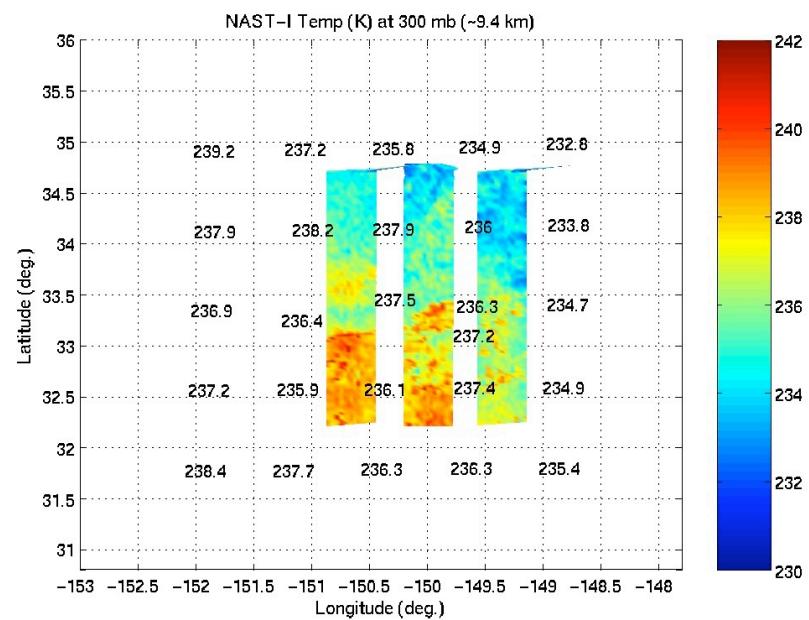
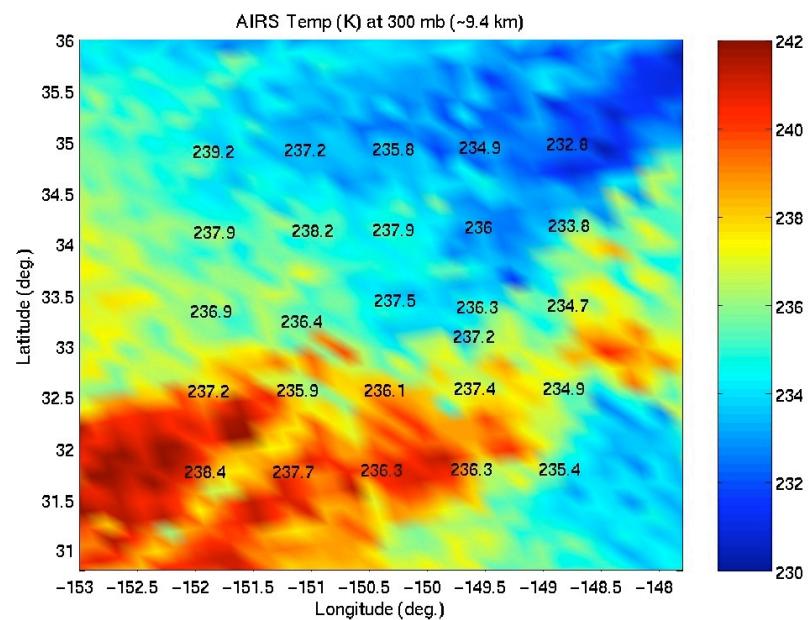
Relative Humidity (March 11/12, 2003)



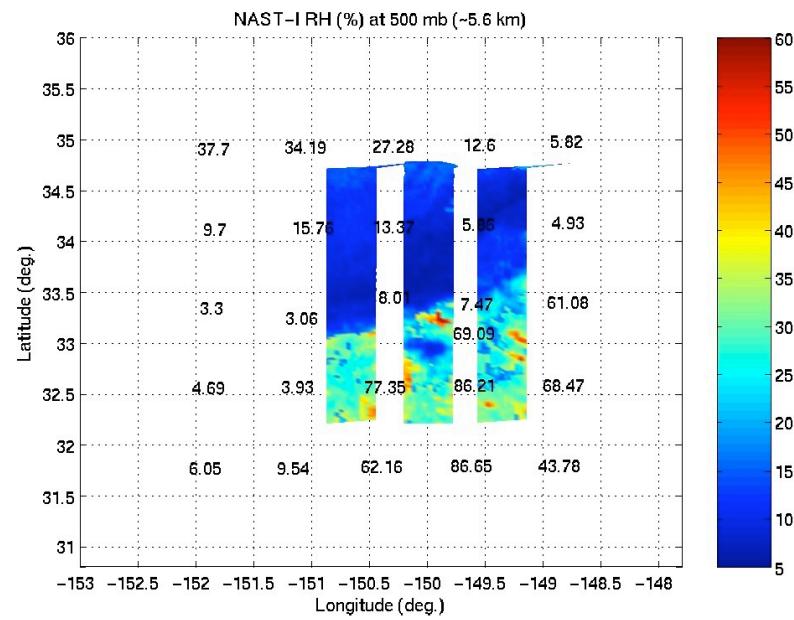
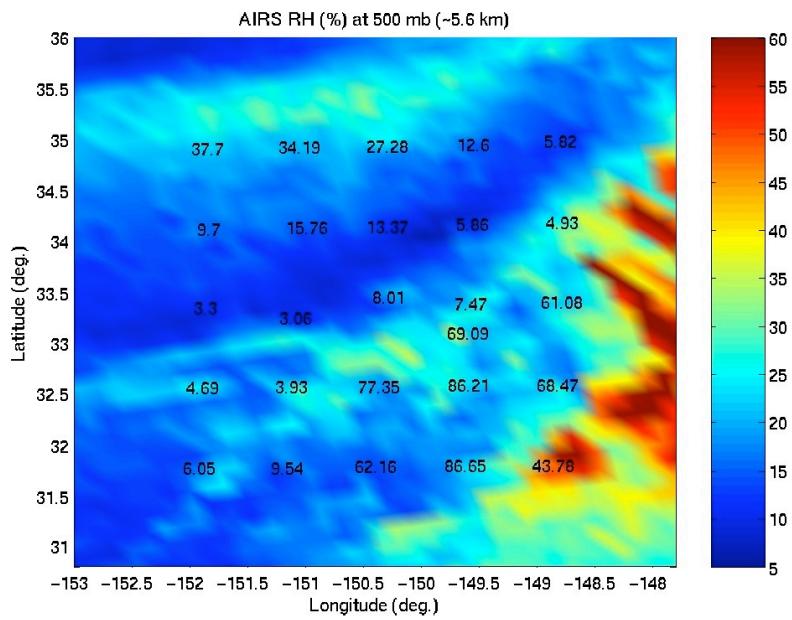
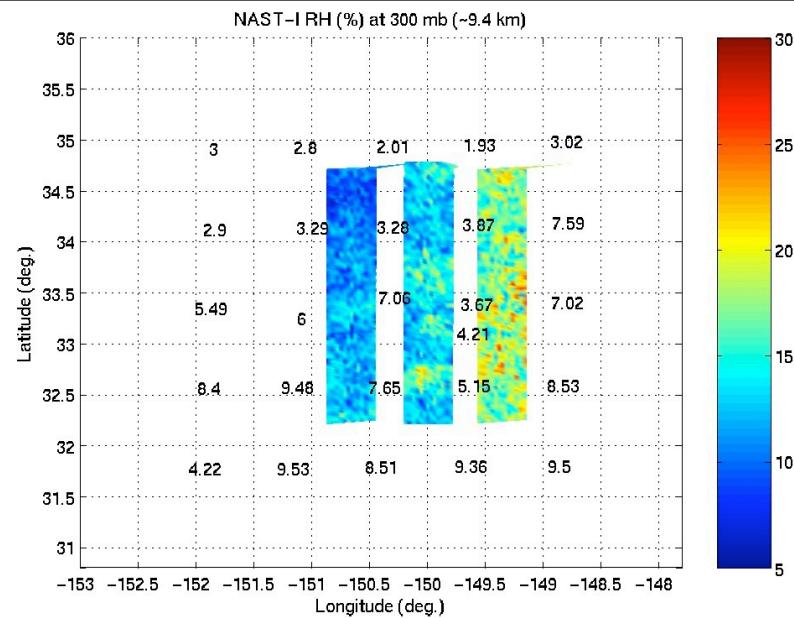
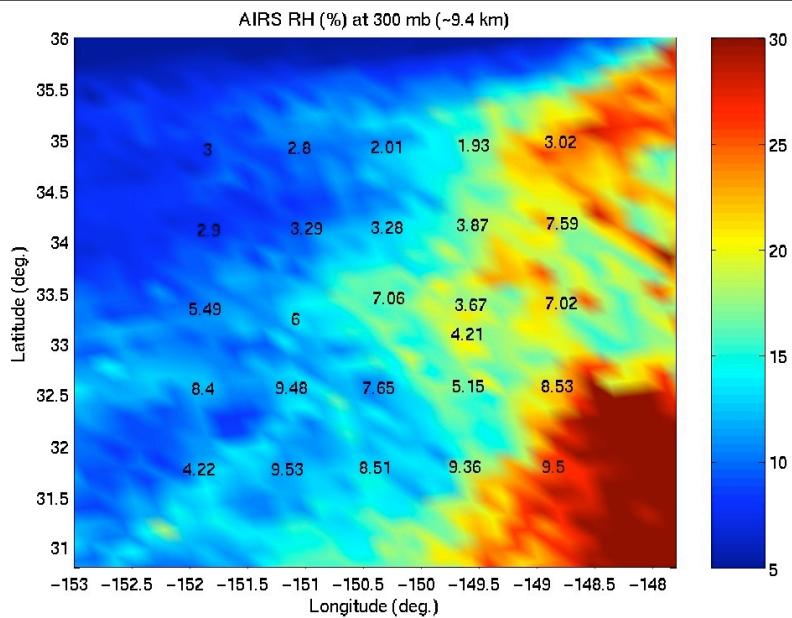
Relative Humidity (March 11/12, 2003)



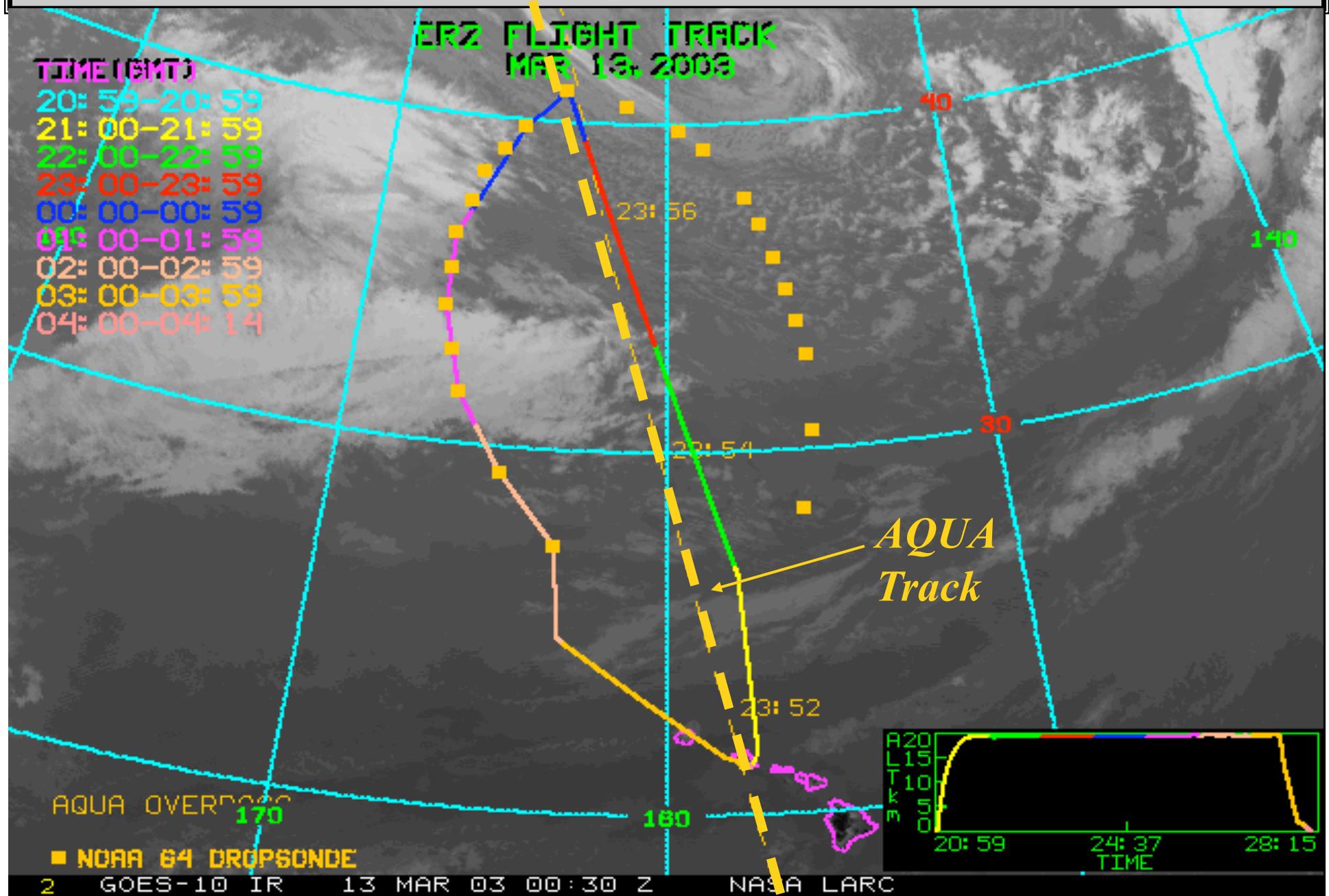
Temperature (March 11/12, 2003)



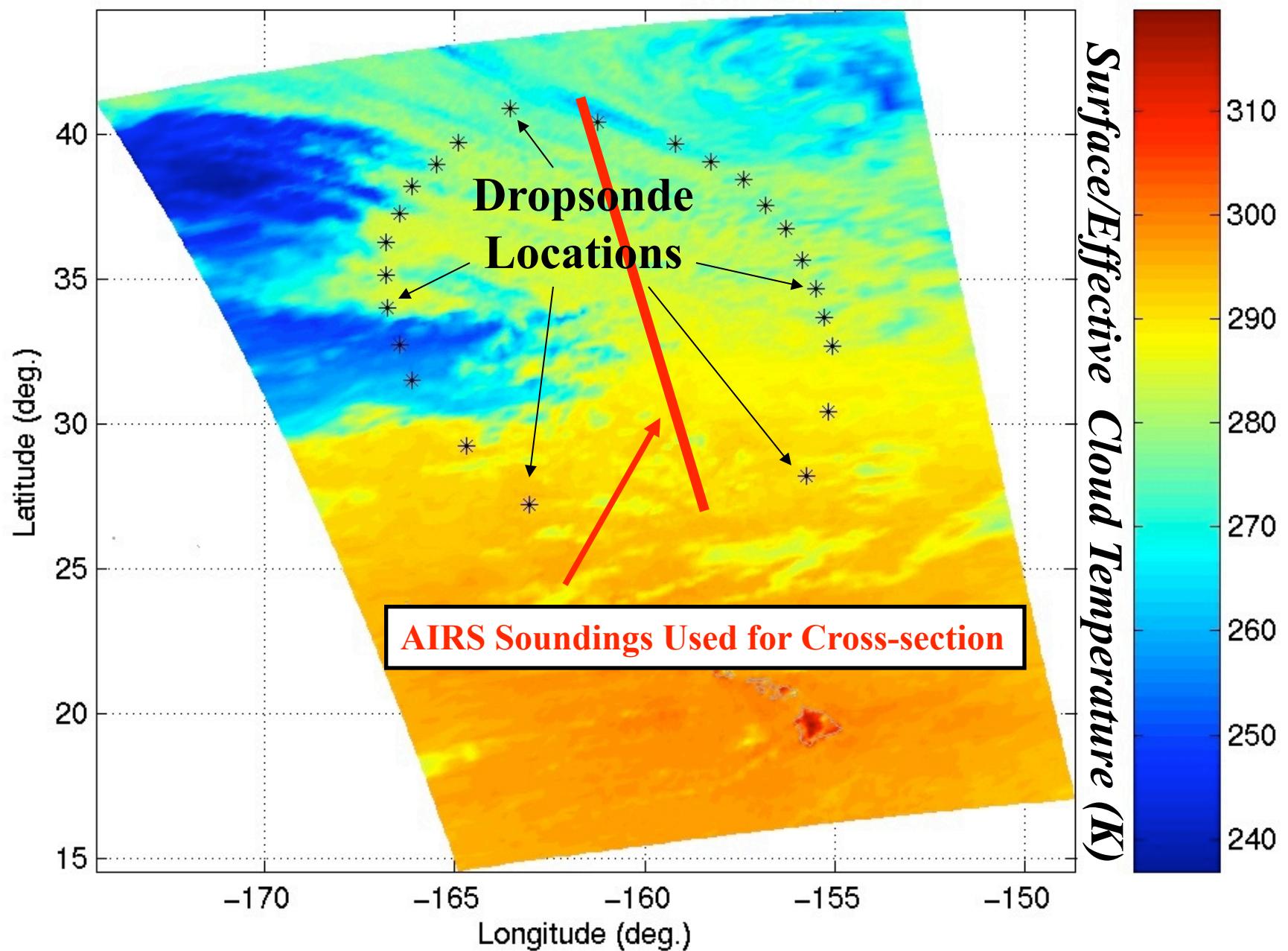
Relative Humidity (March 11/12, 2003)



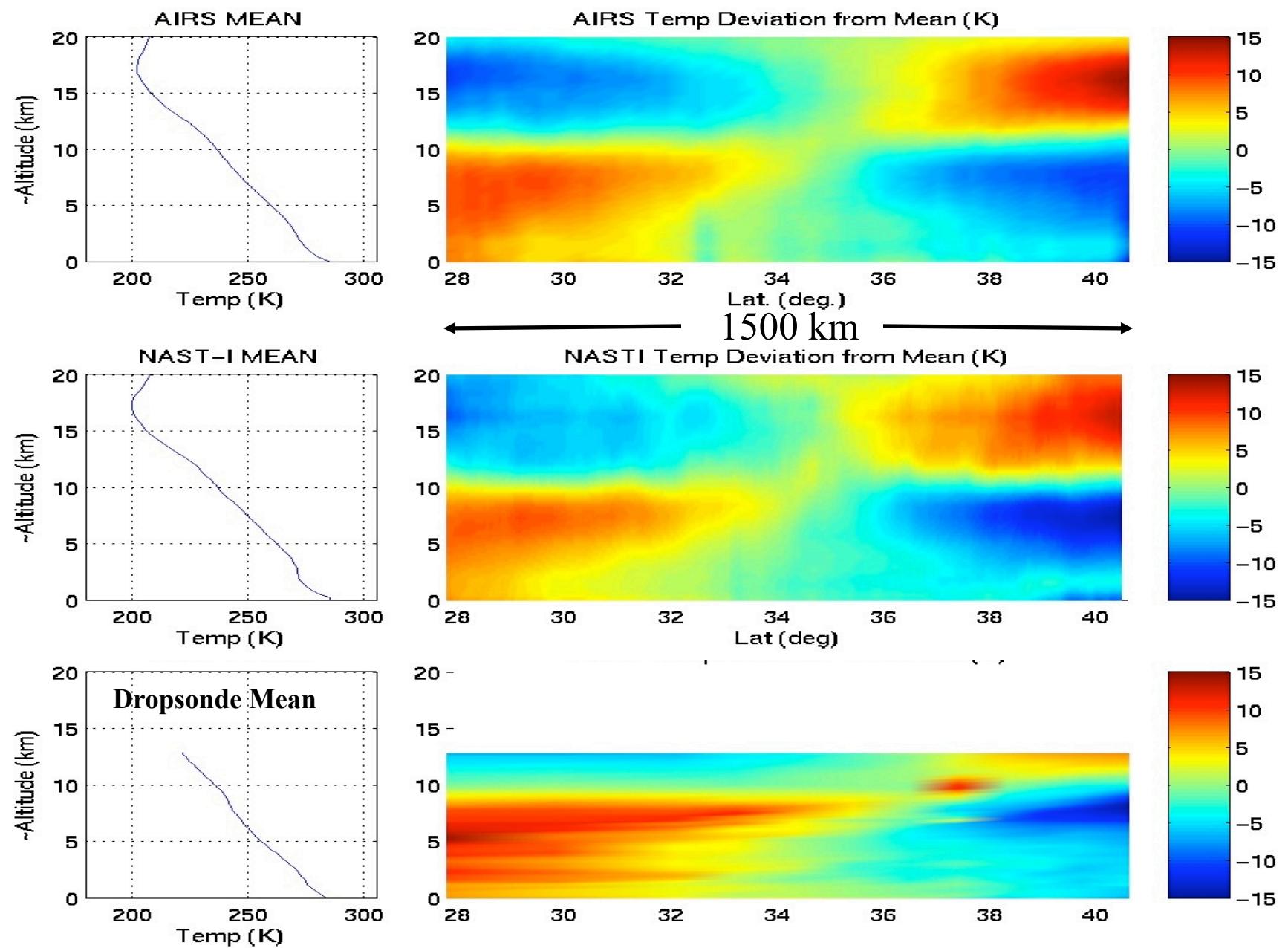
Aqua Overpass Flight (March 12/13, 2003)



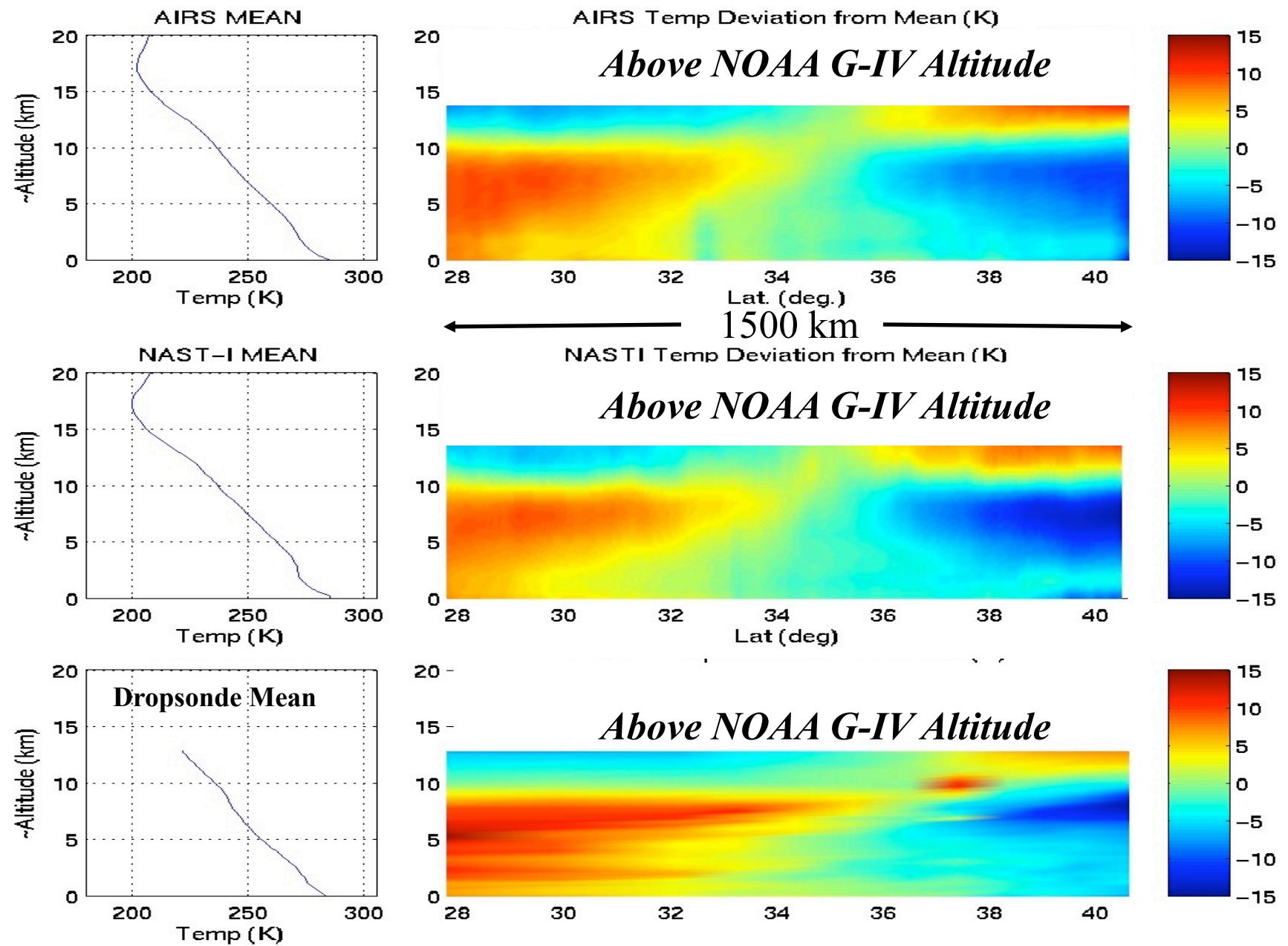
AIRS and Dropsonde Data Used for Intercomparison



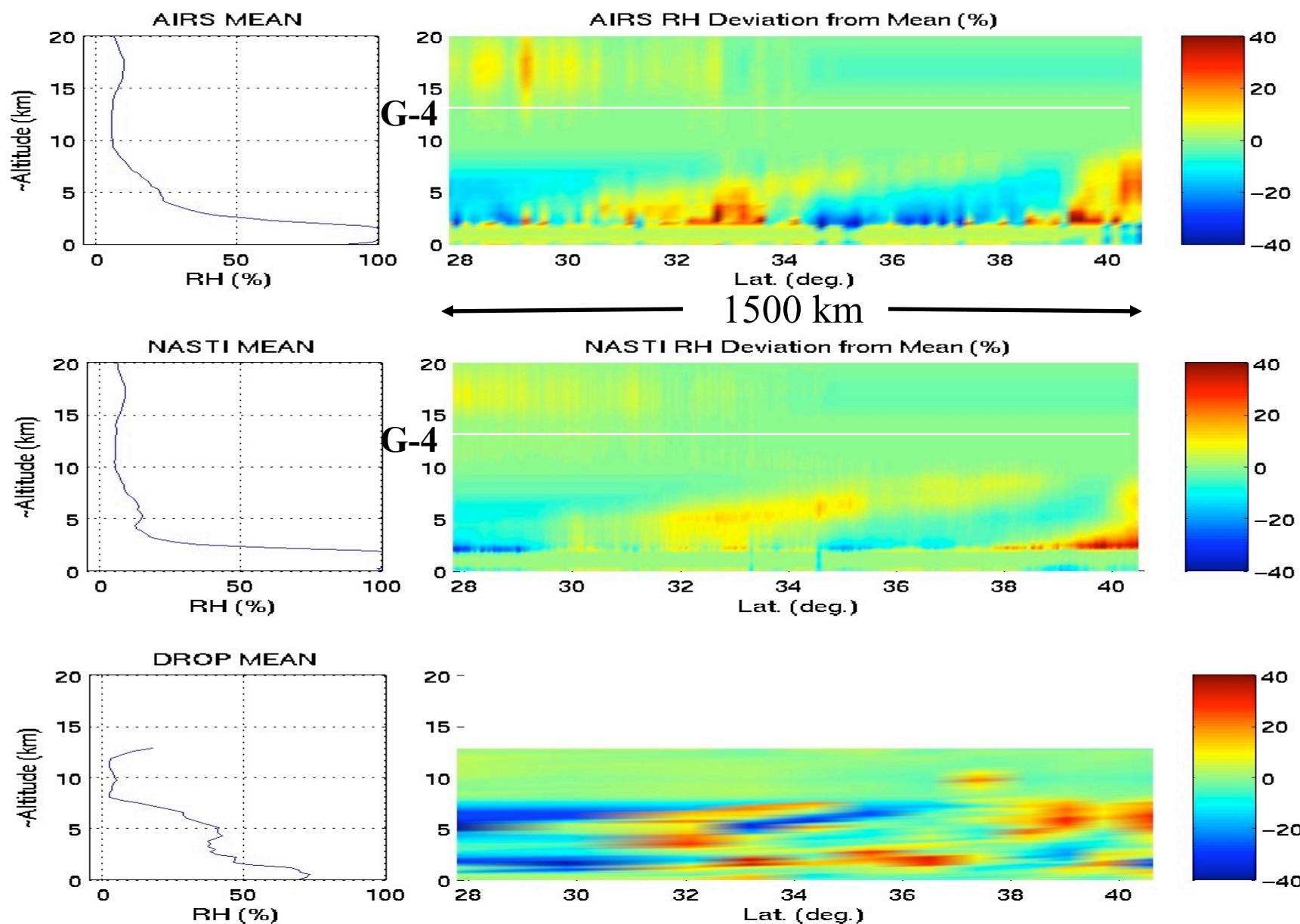
Retrieval Comparisons (Deviation from the Mean)

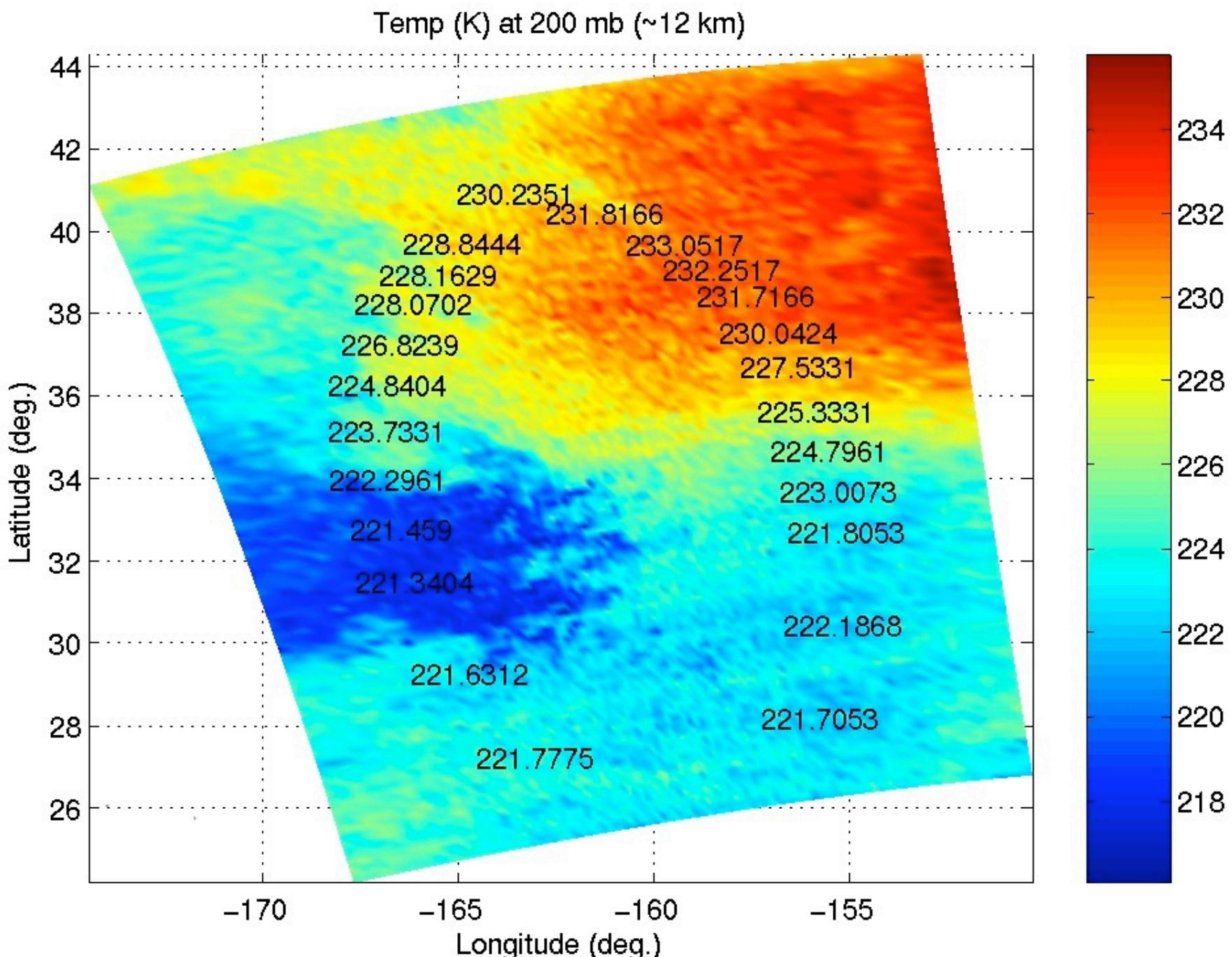


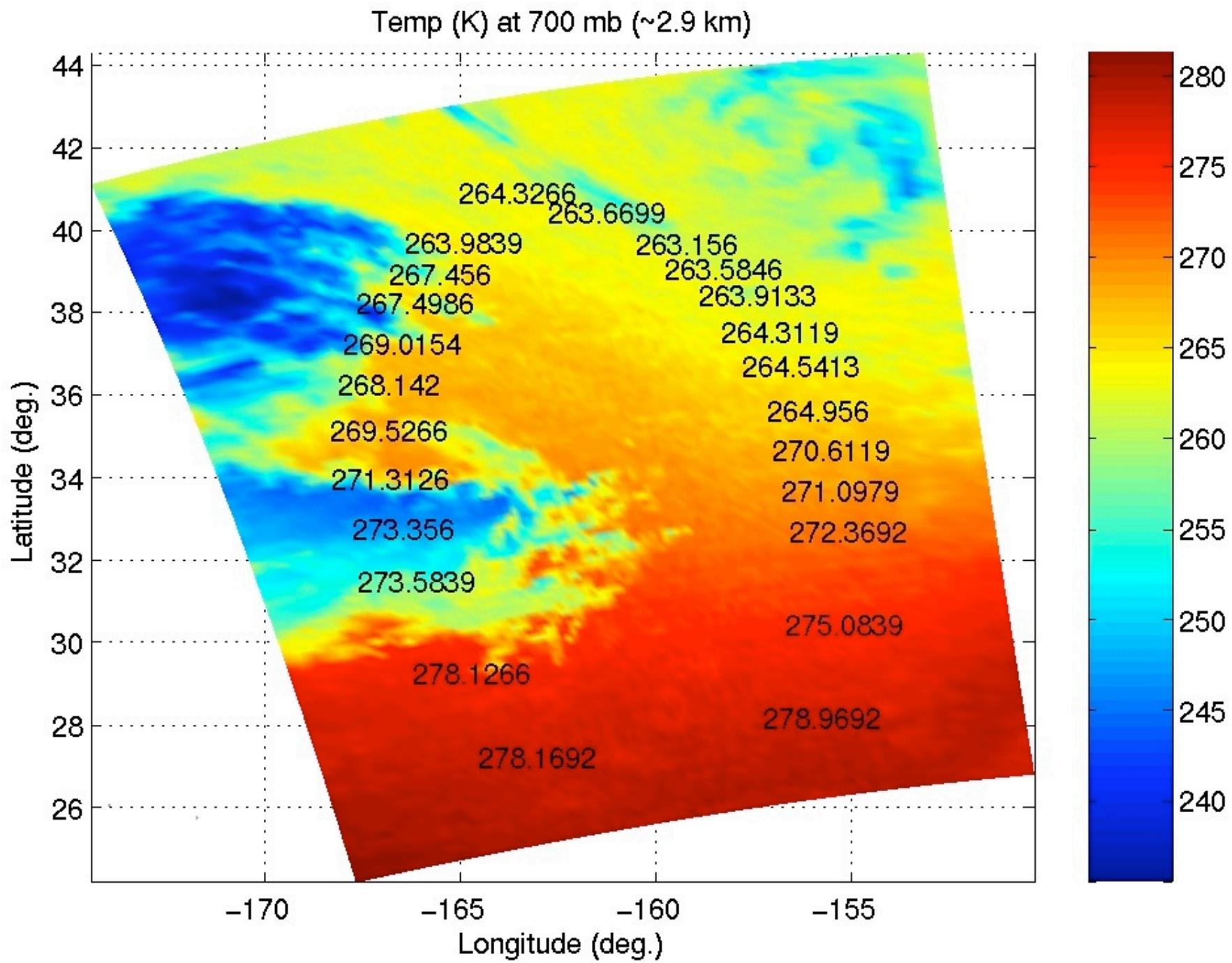
Retrieval Comparisons (Deviation from the Mean)



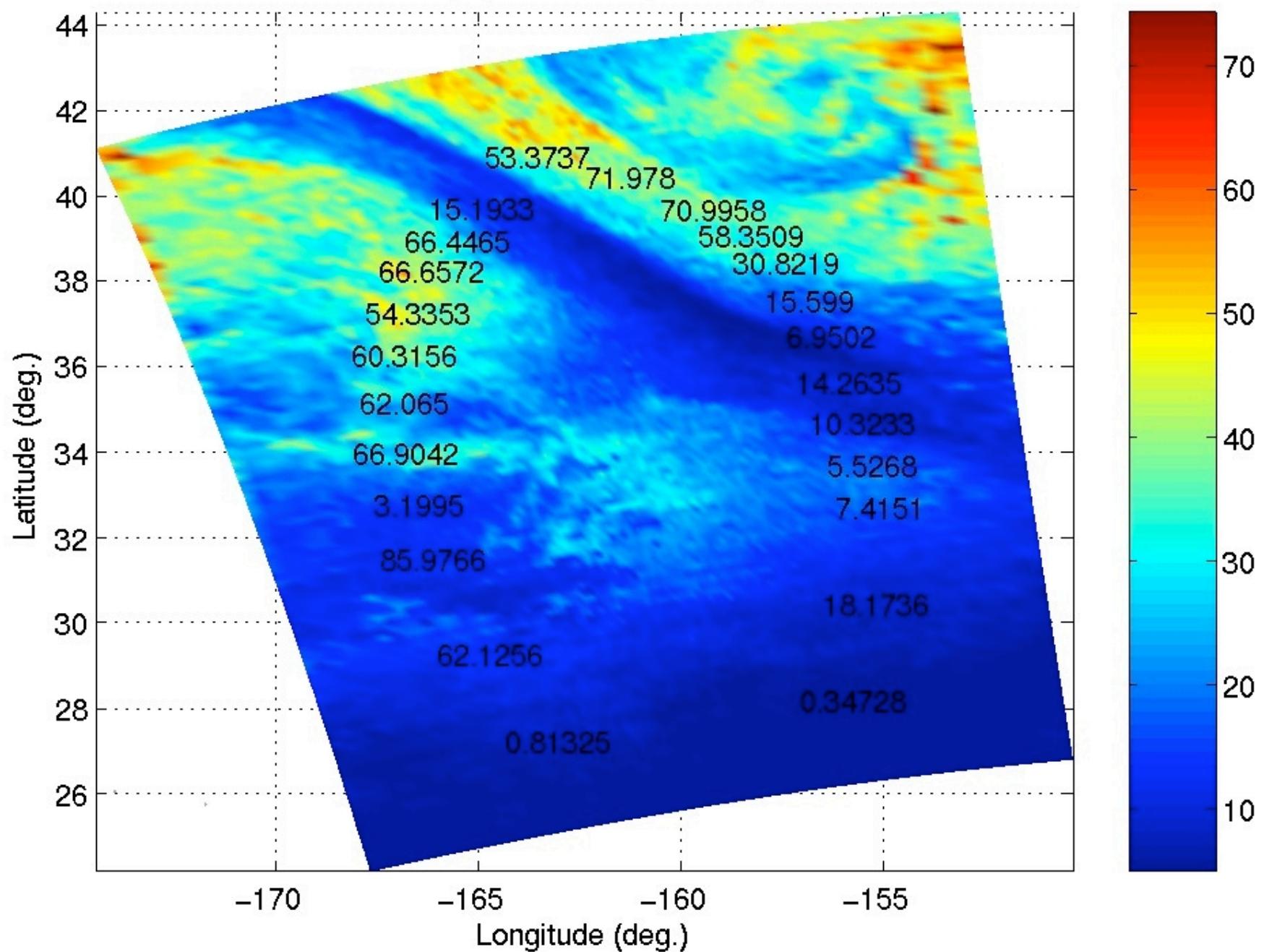
Retrieval Comparisons (Deviation from the Mean)







RH (%) at 500 mb (~5.6 km)



Summary and Future Validation Opportunities

- *Aqua satellite AIRS and aircraft NAST-I thermodynamic profiles agree well with each other and with in-situ dropsonde measurements. The vertical resolution of AIRS appear to be as advertised (i.e., 1-3 km, depending upon altitude).*
- *Next AIRS NAST/SHIS/MAS/CPL/Dropsonde validation opportunity is Atlantic Thorpex Observational Systems Test (ATOST)-15 Nov. – 15 Dec. 2002 (Bangor, MA)*
- *July 2004 Opportunity: Multi-agency chemistry and air quality measurement program (NE US)*